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(54) **METHOD FOR FORMING POLYMERIZED MICROFLUIDIC DEVICES**

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See application file for complete search history.

References Cited**U.S. PATENT DOCUMENTS**

6,485,625 B1 * 11/2002 Simpson et al. 204/601
6,488,872 B1 12/2002 Beebe
2007/0259366 A1 * 11/2007 Lawrence et al. 435/6

FOREIGN PATENT DOCUMENTS

WO WO2004009489 A2 1/2004

OTHER PUBLICATIONS

David J. Beebe; Jeffrey S. Moore; Qing Yu; Robin H. Liu, Mary L. Kraft; Byung-Ho Jo; Chelladurai Devadoss; "Microfluidic tectonics:

"A comprehensive construction platform for microfluidic systems", PNAS, 2000, vol. 97, No. 25, pp. 13488-13493.

Christopher Khoury; Glennys A. Mensing; David J. Beebe; "Ultra rapid prototyping of microfluidic systems using liquid phase photopolymerization", Lab Chip, 2002, vol. 2, pp. 50-55.

J. Brian Hutchinson; K. Tommy Haraldsson; Brian T. Good; Robert P. Sebra; Ning Luo, Kristi S. Anseth; Christopher N. Bowman; "Robust polymer microfluidic device fabrication via contact liquid photolithographic polymerization (CLiPP)", Lab Chip, 2004, vol. 4, pp. 658-662.

Neil B. Cramer; Sirish K. Reddy; Michael Cole; Charles Hoyle; Christopher N. Bowman; "Initiation and Kinetics of Thiol-ene Photopolymerizations without Photoinitiators", Journal of Polymer Science: Part A; Polymer Chemistry, 2004, vol. 42, pp. 5817-5826. Helen M. Simms; Christopher M. Brotherton; Brian T. Good; Robert H. Davis; Kristi S. Anseth; Christopher N. Bowman; "In situ fabrication of macroporous polymer networks within microfluidic devices by living radical photopolymerization and leaching", Lab Chip, 2005, vol. 5, pp. 151-157.

(Continued)

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ABSTRACT

Methods for making a microfluidic device according to embodiments of the present invention include defining a cavity. Polymer precursor solution is positioned in the cavity, and exposed to light to begin the polymerization process and define a microchannel. In some embodiments, after the polymerization process is partially complete, a solvent rinse is performed, or fresh polymer precursor introduced into the microchannel. This may promote removal of unpolymerized material from the microchannel and enable smaller feature sizes. The polymer precursor solution may contain an initiator. Polymerized features therefore may be capped with the initiator, which is photoactive. The initiator may aid later binding of a polyacrylamide gel to the microchannel surface.

13 Claims, 4 Drawing Sheets

